

REMARKS

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Claim 1 has been amended to incorporate the limitations of claim 18, as a result of which claim 18 has been cancelled. Claims 2-5 have been cancelled and claims 11 and 12 have been amended as a result of the amendment to claim 1, to prevent redundancy of claim limitations. Claim 14 has been amended to replace the term “burnishing” with “deep rolling”. As is discussed in detail below, the term “burnishing” is actually a poor translation of the French word “galetage”. A good translation of this term is “deep rolling”. Additionally, support for this amendment can be found on page 1, lines 18-29 of Applicants’ specification.

The patentability of the present invention over the disclosures of the references relied upon by the Examiner in rejecting the claims will be apparent upon consideration of the following remarks.

Thus, the rejection of claims 1-18 under 35 U.S.C. § 103(a) as being unpatentable over Bellus et al. in view of Heffron et al. is respectfully traversed.

The Examiner takes the position that Bellus et al. disclose a method of fabricating a steel part for automotive components by subjecting metal blank to forging and cooling. The Examiner admits that Bellus et al. fail to include the additional step of mechanical reinforcing. However, the Examiner asserts that it would be an obvious step to incorporate since it is a standard conventional finishing step well known in the art when producing crankshafts for automobiles, as taught by Heffron et al.

Applicants previously argued that burnished, as discussed by Heffron et al., does not refer to a mechanical reinforcing operation, but rather a machining operation which aims at making the bearing surface as smooth as possible. Applicants’ use of the term “burnishing” refers to a mechanical reinforcing performed with rolls which cause high compressive mechanical residual stresses and surface hardening. The Examiner asserts that the burnishing step of Heffron et al. is equivalent to the burnishing recited in Applicants’ claim 14, since the techniques of using rollers on forging surface are the same.

Applicants respectfully disagree. Initially, Applicants assert that the misunderstanding of the term “burnishing” is the result of a poor translation of the French word “galetage”. A good translation of the term “galetage” is “deep rolling”, which means supplying a high pressure by wheels (rolls) on a high depth of the product (4-5 mm). This operation is well defined on page 1, lines 18-29 of Applicants’ specification. The object of this operation is to obtain a strong strain-hardening of the metal. Furthermore, Applicants enclose herewith a document which shows that “machine a galeter” translates to “roller finishing and deep rolling machines”. (Please see excerpt from EMO Hannover, attached hereto.) Therefore, “deep rolling” is a usual translation for “galetage”.

On the contrary, “burnishing” refers to an operation, the aim of which is to obtain a smooth, polished surface by way of machining, which is performed with cutting tools. Heffron et al. teach that burnishing is performed in order to obtain the final bearing finish, that is a determined surface quality after a preliminary machining and grinding. (See column 1, lines 22-23 of Heffron et al.)

Burnishing (or machining), as taught by Heffron et al., and deep rolling, as recited by Applicants, cannot be performed with the same tools. A machining/burnishing step needs cutting tools, while deep rolling needs wheels/ rolls with smooth surfaces, without any cutting parts.

Furthermore, the parts of the crankshaft treated in Heffron et al. and in the present invention are not the same. Heffron et al. teach burnishing the bearing surfaces. (See column 1, lines 20-22 of Heffron et al. On the contrary, in Applicants’ invention it is primarily the fillets connecting the crank pins and the bearing which are deep rolled. (See page 6, lines 30-32 of Applicants’ specification.) The bearings are not part of the crankshaft which undergoes particularly high stresses, while the fillets undergo high flexion strains which can lead to fatigue. (See page 4, line 33 to page 5, line 33 of Applicants’ specification.) The question of a polished state of the crankshaft surface does not play any part in this mechanism. In fact, a polished state is not even desired on the deep-rolled fillets, since the building of cracks is involved by the deep rolling operation. Consequently, once it is understood that the translation of term “galetage” was poor, it is

clear that the teachings of Heffron et al. have nothing to do with Applicants' claimed invention. Therefore, Heffron et al. does not remedy the deficiencies of Bellus et al.

Additionally, Applicants previously argued that claim 18 (now incorporated into amended claim 1) was patentable over the cited references because neither of the cited references teaches or suggests a steel which contains 0.005 to 0.06% Nb, 0.005 to 0.04% Ti, where the Ti content is equal to at least 3.5 times the N content, and 5 to 50 ppm B. The Examiner asserts that Bellus et al. disclose steel examples having a composition which meets the recited claims. The Examiner further asserts that Bellus et al. do not teach N as an alloying constituent, and therefore N would be present at an inevitable impurity level kept as low as possible since it would be an undesirable element. The Examiner further states that having Ti amounts equal to at least 3.5 times the N content would be expected by the prior art alloy, because it contains a high Ti content of 0.005 to 0.03%, and a low impurity N level.

However, if $Ti = 0.023\%$, as in the examples of Bellus et al., then N would have to be less than 0.0065% in order to possess the required ratio as recited in Applicants' claims. Such an N content is not particularly low, and it is very easy to unintentionally obtain much high contents of N. This is particularly true when the steel is obtained from melted scraps in an electric furnace, as is most often the case for steels, which will be forged later, as in the invention and in Bellus et al.

Additionally, the Examiner has completely neglected the fact that Bellus et al. and Applicants' invention have completely different requirements on the thermomechanical treatments undergone by their steels, which lead to different metallurgical structures. Consequently, (1) the parts obtained by Bellus et al. have mechanical properties which do not make them particularly fit for making crankshafts, and (2) performing a deep rolling on these parts, which can have up to 20% ferrite in their structure, would not allow the benefit of the advantages of Applicants' invention; on the contrary, such a structure is detrimental when it is deep rolled.

Bellus et al. (which has the same owner as the present application) needs very particular thermal treatments, since the cooling between 600 and 300°C needs a long stay at precise temperatures within this range.

On the contrary, Applicants' invention requires a continuous cooling within this range, either in still air or by blowing air onto the crankshaft, according to its dimensions, in order to guarantee a cooling speed of $\leq 3^{\circ}\text{C/s}$ between 600 and 300°C , which leads to a 100% bainite structure.

In Bellus et al., if bainite is formed, it is always lower bainite (due to the interruption of the cooling). At 700°C , Bellus et al. aim for a cooling speed of $> 0.5^{\circ}\text{C/s}$, preferably $> 2^{\circ}\text{C/s}$, down to a temperature T_m between $M_s + 100^{\circ}\text{C}$ and $M_s - 20^{\circ}\text{C}$. (See column 3, line 62 to column 4, line 11.) T_m lies between 600 and 300°C . There is no upper limit to the cooling speed in this interval. On the contrary, in Applicants' invention, there is an upper limit of 3°C/s but without any interruption, in order to obtain a bainitic structure, without martensite.

Further, the invention of Bellus et al. tolerates up to 20% ferrite. On the contrary, ferrite is not present in Applicants' steel. This exclusion comes from the desired effects of the combination of a 100% bainitic structure and of the deep rolling. The deep rolling operation is very detrimental, if performed on the ferrite, and can lead to a cracking of the steel. It can be seen in the present application that the reference example which contains ferrite (ferrite-pearlitic structure) has very poor fatigue results after deep rolling.

Additionally, trials were performed on examples of a steel having a 100% bainitic structure, corresponding to the second implementation of the invention as described on page 11, lines 3-25 of Applicants' specification. The composition of this steel was $\text{C}=0.299\%$; $\text{Mn}=1.478$; $\text{Si}=1.160\%$; $\text{Ni}=0.169\%$; $\text{Cr}=0.870\%$; $\text{Mo}=0.104\%$; $\text{V}=0.114\%$; $\text{Cu}=0.963\%$; $\text{Nb}=0.052$; $\text{B}=30\text{ppm}$; $\text{Ti}=0.028\%$; $\text{N}=70\text{ppm}$, which gives $\text{Ti}/\text{N}=4$, so >3.5 ; $\text{S}=0.024\%$; and $\text{Al}=0.021\%$. After forging and cooling in still air at 0.5 to 1°C/s , as 100% bainitic structure was obtained and no further tempering or annealing was performed.

A remarkably high tensile strength of 1197 MPa was obtained, as well as a remarkably high yield strength of 766 MPa . These values are much higher than those for the reference steel described on page 12, lines 12-31 (860 MPa tensile strength and 570 MPa yield strength). After deep rolling the sample in the same conditions as for the reference steel, also with applied loads of 800 - 1200 daN , cracking started to occur for moments of 2150 to 2220 N.m , and rupture moments were 5600 to 5880 N.m . These are

significantly better values than for the reference steel. (See page 12, lines 26-31.) Specifically, the improvement for the cracking starting moment is 12% and 32% for the rupture moment.

For the above reasons, the invention of claims 1-18 are clearly patentable over Bellus et al. in view of Heffron et al.

Therefore, in view of the foregoing amendments and remarks, it is submitted that the ground of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

Respectfully submitted,

Herve MICHAUD et al.

By: 

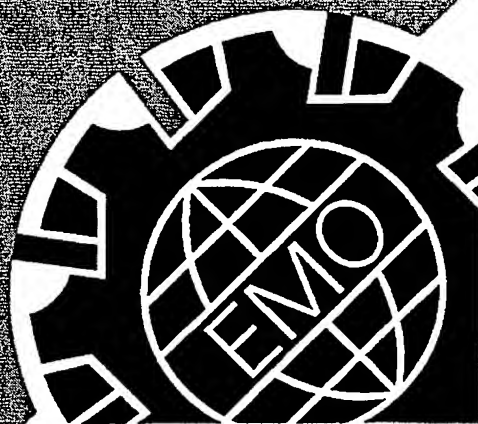
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July 3, 2006

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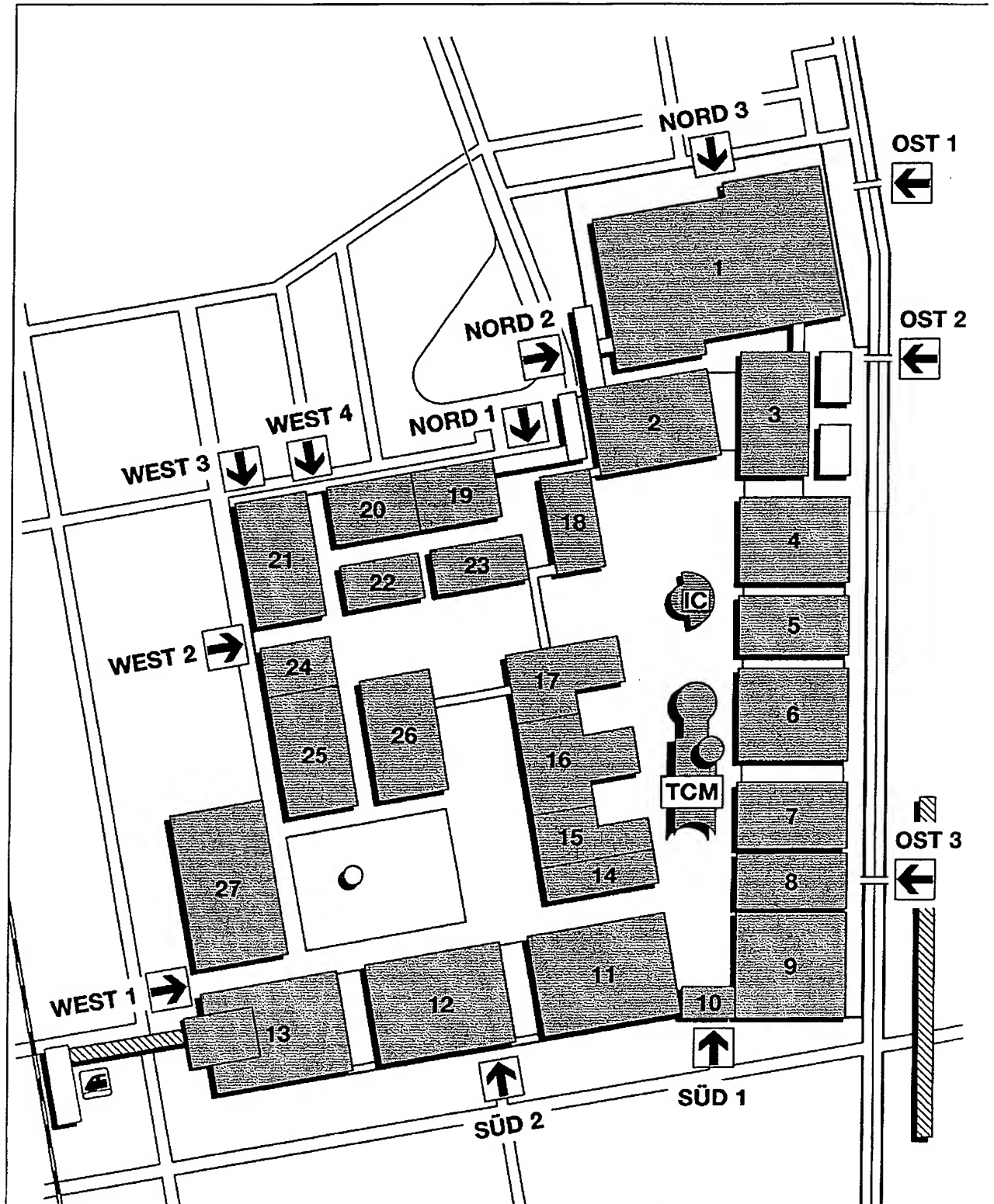
SUCHWORTVERZEICHNIS

INDEX OF PRODUCTS

RÉPERTOIRE DES MACHINES ET ACCESSOIRES

REPERTORIO TECNOLOGICO

Ausstellungsgelände
Exhibition Grounds
Parc des Expositions
Quartiere espositivo





**Suchwortverzeichnis,
numerisch**

- A** Werkzeugmaschinen
- B** Sonstige Maschinen
- C** Präzisionswerkzeuge
- D** Bauteile, Baugruppen, Zubehör
- E** Fertigungs- und Prozessautomatisierung
- F** Messtechnik und Qualitätssicherung
- G** Dienstleistungen



**Index of products,
numerical**

- A** Machine tools
- B** Other machines
- C** Tooling
- D** Parts, components, accessories
- E** Manufacturing and process automation
- F** Metrology
- G** Services



**Répertoire des machines
et accessoires,
numérique**

- A** Machines outils
- B** Autres machines
- C** Outillages/Outils
- D** Equipements, composants, accessoires pour machines-outils
- E** Automatisation des systèmes de production
- F** Métrologie et contrôle de la qualité
- G** Services



**Repertorio tecnologico,
numerico**

- A** Macchine utensili
- B** Altre macchine
- C** Utensileria
- D** Parti, componenti e accessori
- E** Automazione delle lavorazioni e dei processi
- F** Metrologia e controllo di qualità
- G** Servizi



**Suchwortverzeichnis,
alphabetisch**



**Index of products,
alphabetical**



**Répertoire des machines
et accessoires,
alphabétique**



**Repertorio tecnologico,
alfabetico**

16.00 Machines à couper les tôles

16.01	Cisailles à coupe longitudinale	16.08	Machines de découpe par laser	16.14	Machines à cisailer pour refendre les feuillets et machines à cisailer à molettes
16.02	Lignes de refendage	16.09	Machines de découpe par plasma	16.15	Machines à cisailer à guillotine
16.03	Machines à cisailer	16.10	Machines de découpe par jet d'eau	16.16	Cisailles à brames
16.04	Lignes de coupe à longueur et de refendage	16.11	Machines à tronçonner	16.17	Cisaille à levier
16.05	Machines à dresser et à couper les feuillets	16.12	Machines à cisailer (pour découpage de disques)	16.18	Machines autres à travailler les métaux en feuilles et bandes
16.06	Machines à ébarber	16.13	Cisailles à lames courbes		
16.07	Machines de coupe pour formes creuses				

17.00 Machines de découpage, poinçonnage des tôles

17.01	Machines à poinçonner	17.05	Machines à gruger	17.09	Presses à haute productivité à alimentation automatique
17.02	Poinçonneuses revolver	17.06	Machines à perforer	17.10	Presses à plateau revolver
17.03	Machines combinées de poinçonnage et découpage par laser	17.07	Machines à grignoter	17.11	Machines combinées à cisailer et à grignoter
17.04	Machines universelles à cisailer et à poinçonner (gruger)	17.08	Presses de découpage fin	17.12	Machines à cisailer, à grignoter, à gruger, à poinçonner, autres

18.00 Machines de formage des tôles

18.01	Presses-pleuses	18.07	Machines à serrer les agrafes	18.13	Tours à repousser et à fuotourner
18.02	Machines à rouler les tôles	18.08	Machines à plier les tôles	18.14	Machines à moleter
18.03	Machines à planer, dresser les tôles	18.09	Machines à canneler	18.15	Machines pour la fabrication de tôles ondulées
18.04	Presses à cintrer et rectifier	18.10	Machines à ébarber et à border	18.16	Machines d'emboutissage par étréage
18.05	Machines à planer par étréage	18.11	Machines à profiler les tôles, à galets	18.17	Machines de formage des profilés
18.06	Presses à former par étréage	18.12	Machines à cintrer pour formes creuses	18.18	Autres machines de formage des tôles

19.00 Installations et cellules pour le travail de la tôle

19.01	Centres d'usinage de poinçonnage et de cisailage	19.03	Installations flexibles pour le travail de la tôle	19.05	Centres de pliage
19.02	Centres pour le travail des tôles	19.04	Installations flexibles de formage	19.06	Centres de découpe

20.00 Presses

20.01	Presses hydrauliques	20.10	Presses à frapper	20.20	Presses à plateau revolver
20.02	Presses mécaniques	20.11	Presses à balancer	20.21	Presses à double effet
20.03	Presses pneumatiques et hydropneumatiques	20.12	Balanciers à vis à friction	20.22	Presses à emboutir
20.04	Presses à bâti en col de cygne	20.13	Presses d'établir	20.23	Presses à emboutir à engrenages
20.05	Presses à excentrique à bâti en col de cygne, fixes	20.14	Presses à arcades ou à montants	20.24	Presses à emboutir à grande distance entre montants
20.06	Presses à excentrique à bâti en col de cygne, inclinables	20.15	Presses à colonnes	20.25	Presses à emboutir à manivelle à grande distance entre montants
20.07	Presses à pédaler	20.16	Presses à deux et quatre colonnes	20.26	Presses à transfert à poinçons multiples
20.08	Presses à genouillère	20.17	Presses à deux bielles	20.27	Presses transfert pour pièces de grands formats
20.09	Presses à manivelle	20.18	Presses à emboutir à quatre points	20.28	Presses pour l'hydroformage
		20.19	Presses à levier à main		

21.00 Presses pour utilisations spéciales

21.01	Machines à river les tôles	21.06	Machines à marquer	21.11	Machines et outils pour assembler et raccorder par pression
21.02	Presses à matricer	21.07	Presses monétaires	21.12	Presses à dresser
21.03	Presses à plusieurs postes pour pièces de forme	21.08	Machines pour la fabrication des boîtes et emballages métalliques	21.13	Presses à ébarber
21.04	Presses de mise au point des outils	21.09	Presses à paqueter	21.14	Autres presses pour utilisations spéciales
21.05	Presses à calibrer	21.10	Presses à border		

22.00 Machines à travailler les métaux en barres, les profilés et les tubes

22.01	Machines à cintrer les tubes	22.06	Machines automatiques à former, souder et couper les tubes	22.11	Machines à cintrer les barres et profilés
22.02	Machines à rétrécir et évaser les tubes	22.07	Machines à dresser	22.12	Machines à cintrer les fers à béton
22.03	Machines pour le parachèvement des tubes	22.08	Machines à profiler les anneaux	22.13	Coupe-fers à béton
22.04	Machines à couper les tubes	22.09	Machines à galeter	22.14	Cisailles pour profilés, barres et lingots
22.05	Machines pour l'usinage des extrémités des tubes	22.10	Machines à profiler les galets	22.15	Machines pour le finissage de barres et profilés

16.00 Sheet metal cutting machines

16.01 Strip slitting systems, units	16.07 Cutting machines for hollow shapes	16.13 Curve cutting shears
16.02 Slitting lines	16.08 Laser cutting machines	16.14 Gang slitting and rotary shears
16.03 Length cutting machines	16.09 Plasma jet cutting machines	16.15 Guillotine shears
16.04 Cutting-to-length and slitting lines	16.10 Water jet cutting machines	16.16 Slab shears
16.05 Strip levelling and cutting-off machines	16.11 Cutting-off grinders	16.17 Hand lever shears
16.06 Trimming machines	16.12 Circle (disc) cutting shears	16.18 Other sheet and strip working machines

17.00 Sheet metal blanking, punching machines

17.01 Punching machines	17.05 Notching machines	17.10 Dial feed presses or rotary table presses
17.02 Turnet punch presses	17.06 Perforating machines	17.11 Combined curve-cutting and nibbling machines
17.03 Combined punching and laser-cutting machines	17.07 Nibbling machines	17.12 Other shearing, nibbling, notching and punching machines
17.04 Universal shearing and punching (notching) machines	17.08 Fine blanking presses	
	17.09 High production presses with automatic feed	

18.00 Sheet metal forming machines

18.01 Press brakes	18.07 Seaming machines	18.13 Spinning machines
18.02 Sheet metal bending machines	18.08 Folding machines	18.14 Knurling machines
18.03 Sheet metal levelling machines	18.09 Crimping machines	18.15 Corrugating machines
18.04 Bending and straightening presses	18.10 Beading and curling machines	18.16 Stretch drawing machines
18.05 Stretching and levelling machines	18.11 Sheet and roller forming machines	18.17 Profile forming machines
18.06 Stretch forming presses	18.12 Rollforming machines for hollow components	18.18 Other sheet metal forming machines

19.00 Sheet metal working cells and systems

19.01 Machining centres for punching and bending	19.03 Flexible sheet metal working systems	19.05 Bending centres
19.02 Sheet metal working centres	19.04 Flexible forming and shaping systems	19.06 Cutting centres

20.00 Presses

20.01 Hydraulic presses	20.11 Fly presses	20.21 Double action presses
20.02 Mechanical presses	20.12 Friction screw presses	20.22 Deep drawing presses
20.03 Pneumatic and hydropneumatic presses	20.13 Bench presses	20.23 Geared drawing presses
20.04 Open front presses	20.14 Straight sided presses	20.24 Wide frame drawing presses
20.05 Open front non inclinable eccentric presses	20.15 Column presses	20.25 Wide frame crank drawing presses
20.06 Inclinable eccentric presses	20.16 Double and four column presses	20.26 Transfer presses
20.07 Foot lever presses	20.17 Two point presses	20.27 Large panel transfer presses
20.08 Toggle lever presses	20.18 Four-point drawing presses	20.28 Hydroforming presses
20.09 Crank presses	20.19 Hand lever presses	
20.10 Percussion presses	20.20 Dial feed presses	

21.00 Presses for special applications

21.01 Riveting machines	21.06 Marking machines	21.11 Machines and tools for pressure assembling and joining
21.02 Stamping presses	21.07 Coining presses	21.12 Straightening presses
21.03 Multistation-Partformer	21.08 Can making machines	21.13 Trimming presses
21.04 Die tryout presses	21.09 Scrap baling presses	21.14 Other presses for special applications
21.05 Calibrating presses	21.10 Flanging presses	

22.00 Bar, section and tube working machines

22.01 Tube bending machines	22.07 Straightening machines	22.13 Concrete bar cutters
22.02 Tube reducing and enlarging machines	22.08 Ring rolling machines	22.14 Section, billet, ingot shears
22.03 Tube finishing machines	22.09 Roller finishing and deep rolling machines	22.15 Bar and section finishing machines
22.04 Tube cutting-off machines	22.10 Roller forming machines	22.16 Flexible manufacturing systems for tubes and sections
22.05 Tube ending machines	22.11 Bar and section bending machines	22.17 Other bar, section and tube machines
22.06 Combined automatic tube forming, welding and cutting-off machines	22.12 Bending machines for reinforcing bars	